

Refereed paper

Mismatch between the prevalence of overweight and obese children and adolescents and recording in electronic health records: a cross-sectional study

Paula Otero MD

Physician, Department of Pediatrics, Section on Clinical Pediatrics, Hospital Italiano de Buenos Aires, Argentina and Associate Professor, Department of Health Informatics, Hospital Italiano de Buenos Aires, Argentina

Pablo Durán MD MPH PhD

Physician

Débora Setton MD

Physician, Department of Pediatrics

Section on Nutrition, Hospital Italiano de Buenos Aires, Argentina

Alfredo Eymann MD

Physician

Julio Busaniche MD

Physician

Julián Llera MD

Chair, Department of Pediatrics

Section on Clinical Pediatrics, Hospital Italiano de Buenos Aires, Argentina

ABSTRACT

Background The prevalence of obesity has increased dramatically in recent years. An electronic health record (EHR) can be used to identify and manage overweight and obesity by providing timely information.

Objective To estimate the prevalence of overweight and obesity using anthropometric data from an EHR and to compare it with the frequency of diagnoses of 'overweight' and 'obesity' registered by pediatricians.

Methods Cross-sectional, descriptive analytical study from a sample of records from children aged between 2 and 19 years who had at least one well-child visit registered in the EHR over the 24-month period between 2007 and 2008. The record of a diagnosis of overweight or obesity by physicians was compared with estimations based on body mass index (BMI; World Health Organization Growth Reference Data).

Results Of 14 743 patients aged 2–19 years, 22.1% were overweight and 9.8% were obese. By contrast, a diagnosis of overweight was registered in the EHR for 3.3% of patients, with a figure of 1.1% for obesity. The prevalence of overweight/obesity was lower in adolescents than in children and pre-schoolers. Based on BMI cut-off points, we found that only 11.5% of the overweight or obese patients had these diagnoses registered in the EHR. Referral to a nutritionist or endocrinologist, and the frequency of selected laboratory tests based on BMI categories vary between 11.8 and 52.5%.

Conclusion An EHR can contribute to the identification of a population at risk when there is a sub-registry of these diagnoses by primary care physicians.

Keywords: adolescent, attitude of health personnel, body mass index, child, computerised medical record system, obesity, overweight, prevalence

What this paper adds

- Primary care physicians might be aware of the burden of obesity in the paediatric population, but the increased trend in this epidemic is not properly registered in health records that might help to facilitate quality improvement management efforts.
- The availability of information about anthropometric and clinical data in an electronic health record can help with the earlier identification and management of overweight and obesity in children and adolescents, helping healthcare providers to address the condition and act upon it.

Introduction

Obesity is an important health concern in the paediatric population. Obese children and adolescents are at risk of developing a wide range of co-morbidities such as impaired glucose metabolism, type 2 diabetes, dyslipaemia, hypertension, fatty liver disease, orthopaedic problems, sleep apnoea and psychosocial problems, and have a higher risk of obesity in later life.^{1,2} According to the National Health and Nutrition Examination Survey (NHANES) 2003–2006, obesity rates have increased 2.5- to 3.5-fold in the last four decades among American children, rising to 12.3% in preschoolers, 17% in children and 17.6% in adolescents.³ The First National Nutrition Survey conducted by the Ministry of Health from Argentina in 2004–2005, based on a complex multistage probability sample, estimated that 31.5% of children aged 0.5–6 years were overweight and 10.4% were obese. The survey also found that the prevalence of overweight and obesity in women aged between 10 and 14.9 years was 23.5%, and in women aged between 15 and 19.9 years was 19.9%.^{4,5}

Based on epidemiological relevance and the implications that overweight and obesity at early life stages have throughout the life course, their prevention and management, together with an assessment of growth, nutrition and behaviour are fundamental to the early detection of childhood obesity.^{6,7} Body mass index (BMI) is an accepted measure for assessing overweight status among children and adolescents, making it a simple and useful index for this purpose. Further evaluation with laboratory tests and specialist referral (such as nutrition and endocrinology) should be carried out. This can complete the diagnosis in order to start the correct management, which includes healthy eating and activity, together with other strategies for obesity prevention.⁸

An electronic health record (EHR) can be used to identify and manage overweight and obesity by providing timely information, educating providers regarding their own performance, and guiding child care by the implementation of guidelines and recommendations to help facilitate quality improvement efforts.⁹

The primary objective of this study is to compare the prevalence of overweight and obesity in a paediatric population based on BMI and clinical diagnosis as recorded in an EHR with healthcare information provided by a Health Medical Organisation (HMO). In addition, referral to specialists and the ordering of laboratory tests are compared based on both criteria.

Methods

Setting

The Hospital Italiano de Buenos Aires (HIBA) is a non-profit healthcare academic centre founded in 1853 in Argentina; it has the latest healthcare technology, and more than 1500 physicians and 3500 employees. It has an affiliated HMO that provides healthcare coverage for approximately 150 000 people (18% of whom are in the paediatric age range).

The Department of Pediatrics at HIBA provides care for over 6500 inpatients per year, admitted to hospitals located in the city of Buenos Aires and its suburban area, and there are more than 250 000 children and adolescent outpatient visits per year, including patients from the HMO and other health insurance organisations.

We performed a cross-sectional, descriptive and analytical study that included all patients affiliated to HIBA's HMO, of both genders, who were aged between 2 and 19 years and had at least one well-child visit between 1 January 2007 and 31 December 2008 registered in the EHR.

EHR

Since 1998, HIBA has gradually implemented an in-house-developed health information system with an EHR, called ITALICA. This currently handles all healthcare-related information, both clinical and administrative, from capture to analysis.

Our web-based EHR is patient-centred and problem-oriented, and is fully implemented in the out-

patient setting. Since 2004, the EHR has enabled physicians to enter growth measurements and chart the data on a matrix of XY co-ordinates for all points modelled on WHO Growth Reference Data percentiles. Charts are available for weight, height and head circumference, by gender, from newborn to 19 years of age. The BMI is automatically calculated and the value is shown to the user. Each condition or diagnosis added to a patient's EHR problem list is mapped through a terminology server, which is a piece of software composed of a local interface vocabulary (thesaurus) mapped to a reference vocabulary, SNOMED CT.¹⁰ The terminology server has allowed us to build a local interface terminology that enables users to record clinical data by choosing options from a list of familiar terms, while storing information in a SNOMED CT-compatible form that also provides the equivalent local term in standard classifications like ICD-9CM, ICD-10 or ICPC2 through the SNOMED CT standard cross-maps mechanism.¹¹ Clinical or progress notes are recorded as free text entries linked to the patient's problem list.

Data collection

We based the study on an adaptation of the research methodology of Benson *et al* using similar variables and data extraction from ITALICA.¹²

To estimate the prevalence of overweight and obesity based on anthropometric data, we obtained the patient's weight and length/height from ITALICA at each visit, recorded over the duration of this study; BMI was calculated automatically. For each patient, we selected the highest BMI value for the period analysed. Patients were stratified by age group: preschool child between two and five years, child between six and 12 years and adolescent between 13 and 19 years.

We excluded extreme values for length/height (< 75 cm or > 210 cm) and weight (< 1.5 kg or > 300 kg). Use of this criteria eliminated 5% of the records.

The prevalence of overweight and obesity, defined from the anthropometric data, was estimated based on WHO 2006–2007 BMI references. Data for normal child growth from birth to 5 years are available in the WHO Child Growth Standards (www.who.int/childgrowth/standards/en/) and growth reference data for ages 5–19 years are available in the Growth Reference Data for ages 5–19 years (www.who.int/growthref/en/). Overweight, obesity and severe obesity were defined by a Z-score of ≥ 1 to < 2, ≥ 2 to < 3 and ≥ 3 , respectively.^{13,14}

In order to estimate the frequency of overweight and obesity diagnoses by primary care physicians, we identified the presence of this diagnosis in a patient's problem list in the EHR as related to its SNOMED CT code (Overweight: 414916001, Obesity: 238131007).

In addition, we estimated the frequency of confirmed referral to a nutritionist or endocrinologist, and laboratory results (glycaemia, HDL cholesterol, LDL cholesterol) registered in the EHR as part of the work-up process in the management of patients with these conditions.

Statistical analysis was performed using SPSS 11.0. After data consistency analysis, descriptive and multivariate analyses were performed. Statistical significance was defined at 0.05.

Results

The number of patients included in the study was 14 743, with a median of two visits per patient. This represents 68.7% (14 743/21 460) of all patients in the age group affiliated to HIBA's HMO at the time of the study. Based on anthropometric data recorded in the EHR, 22.1 and 9.8% were classified as overweight and obese, respectively. The prevalence of overweight and obesity was lower in adolescents than in children and preschoolers, as shown in Figure 1. The prevalence of overweight and obesity is >25% in the three groups and >40% in school-age children.

By contrast, 3.3 and 1.1% of patients had a diagnosis of overweight and obesity registered in the EHR, respectively.

The prevalence of overweight and obesity (defined as the diagnosis registered in the EHR) increased directly with the BMI categories, as shown in Figure 2. Based on BMI cut-off points, in 11.5% of those with a BMI Z-score >1, the clinical diagnosis had been recorded in the EHR.

The difference in the prevalence of overweight and obesity based on anthropometric classification and diagnosis registered in the EHR was statistically significant ($\chi^2 = 1305$, $P < 0.001$; $\chi^2 = 976$, $P < 0.001$, respectively).

The frequency of referral to a nutritionist or endocrinologist, and the frequency of selected laboratory tests recorded in the EHR was low in those diagnosed as overweight or obese based on BMI (Figure 3). This ranged between 11.8 and 52.5%, and increased in concordance with the BMI Z-score categories.

When the same comparison was performed based on the diagnosis registered in the EHR, referrals to a specialist or requests for laboratory tests were more frequent. More than 80% of patients with a diagnosis of overweight or obesity registered in the EHR were referred to a specialist. Laboratory tests (HDL, LDL and glycaemia) were slightly more common in the group with a diagnosis of obesity recorded in the EHR (Figure 4).

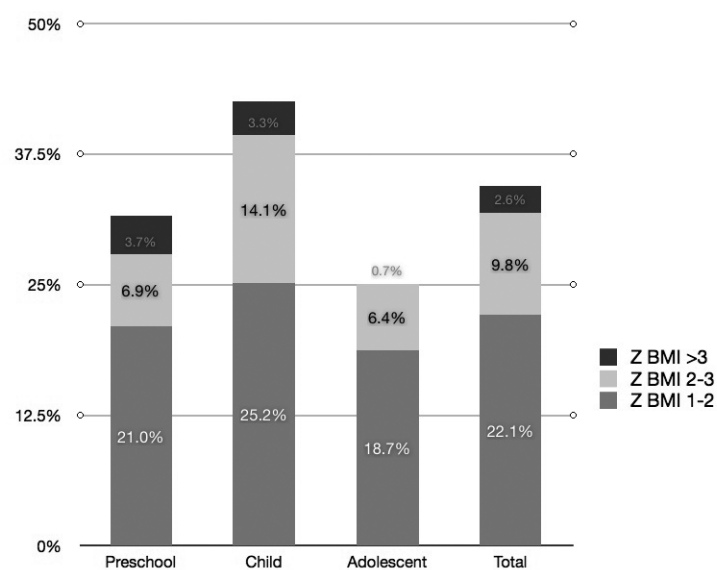


Figure 1 Prevalence of overweight and obesity by age groups, BMI defined by WHO growth standards 2006–2007 ($n = 14\,743$)

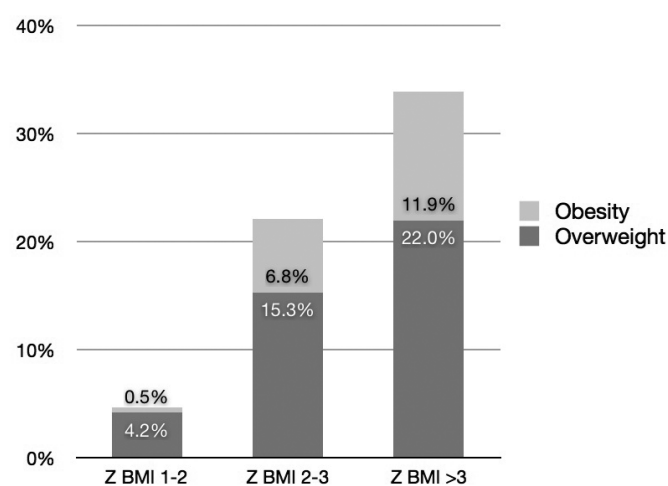


Figure 2 Frequency of diagnosis of overweight and obesity registered in the EHR, by categories of BMI defined by WHO growth standards 2006–2007

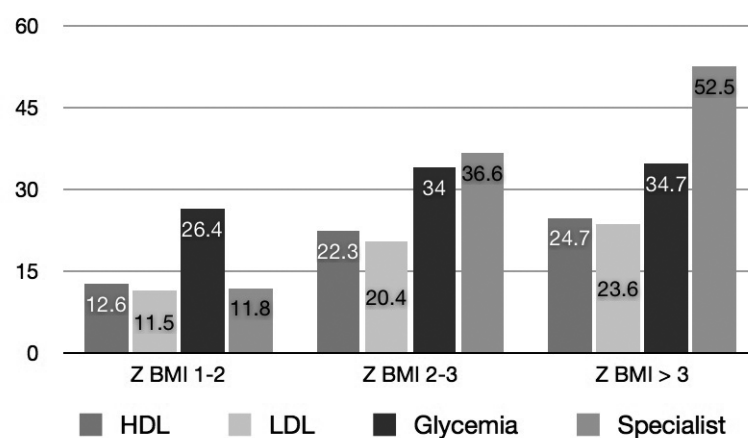


Figure 3 Frequency of selected laboratory tests and referral to specialists by category of BMI

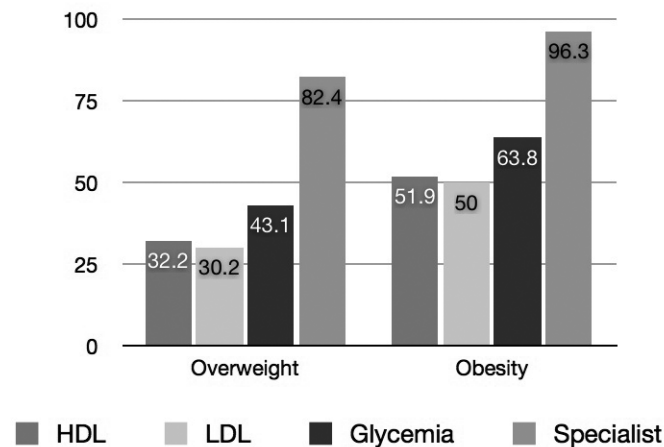


Figure 4 Frequency of selected laboratory tests and referral to specialists by diagnosis recorded by physicians in the EHR

Discussion

Principal findings

We found that the frequency of an overweight/obesity diagnosis registered in the EHR by primary care physicians is lower than that estimated using anthropometric measurements. Physicians also showed little acknowledgement of the problem, as shown by the low frequency of laboratory tests orders and the low number of specialist referrals, which form part of the diagnosis and management work-up strategy in patients with high BMI.

Implications of the findings

The low registration of diagnosis and low frequency of actions to address this might show that physicians are not proactive in controlling the problem; however, this underdiagnosis may highlight two main topics. First, the problem is not sufficiently acknowledged by paediatricians. It has been shown that time-limited consultations, lack of proper training and lack of resources may be barriers to addressing childhood obesity, and also that discussion of 'obesity' during a consultation can negatively affect the patient–physician relationship because it is a sensitive issue.¹⁵ Second, and related to the anthropometric criteria applied in order to define these conditions, WHO Growth References Data are more sensitive in defining overweight than previously used references.¹⁶

In this sense, an EHR offers a simple way to monitor growth by providing access to anthropometric data in the well-being visits. The availability of reminders or

alerts may prompt actions to promote healthy lifestyle behaviours in the outpatient setting.^{9,17}

However, our results show that even in severely obese children ($Z \geq 3$), a diagnosis was not registered in 66.1% of cases, suggesting that use of a more sensible anthropometric tool is not enough, and additional medical education is needed to increase the detection of overweight and obesity. By contrast, when the diagnosis was registered, most of the patients were referred to specialists.

Our results show that only 11.5% of overweight and obese patients are registered in the EHR. Even though the reasons for this under-reporting are beyond the scope of this paper, it is important to be aware of this issue, in order to develop actions aimed at improving early diagnosis and intervention.

One of the premises in the development of our EHR was to integrate it into the clinical workflow, where data are handwritten as free text, and so we did not force physicians to use a structured EHR that might constrain them, but rather we decided to map the problem list through the terminology server to SNOMED CT.

Physicians can create a new problem or use an existing one in order to work with the EHR, so we cannot confirm whether all physicians use their patient's problem list in the proper way or whether they use each problem according to the action they wish to pursue. For example, a physician can use the problem 'health control' to prescribe antibiotics for a urinary tract infection or to order an ultrasound. Currently, physicians are being trained to focus on the importance of there being a clear relationship between the problem list and their activities, so that a longitudinal health record can be used at all the other levels of care (emergency, inpatient and home care). We were aware

that we need to expand our search, beyond the problem list, to evaluate whether better quality care was delivered through specialist referral and test ordering in order to properly measure physicians' activities regarding the management of overweight/obesity. Our findings not only show us that there is low awareness of the obesity burden among physicians, but also that further actions need to be taken in order to promote full use of the EHR's capabilities because recent studies have shown that use of EHR to facilitate the identification of nutritional status can help in the management of obesity in children, enhancing the quality of care provided when compared with not using an EHR.^{17,18}

The EHR used at HIBA is the only way physicians have to register events on patients under their care in the outpatient setting. Our EHR is patient-centred and problem-oriented; physicians enter terms into specific domains (problem list, procedures, discharge summary, etc.) that are mapped through a terminology server. The terminology server of HIBA is composed of a local interface terminology (thesaurus mapped to a reference terminology, SNOMED CT). The thesaurus consists of a list of terms created from almost two million free text inputs extracted from the clinical data repository. The terms included in the thesaurus are divided into concepts (real clinical entities) and descriptions (different ways of naming these clinical entities). The interface terminology is updated daily by a professional team who audit, code and link each new term to the SNOMED CT as a reference terminology, and use the official mapping into SNOMED of other classifications (like ICD-10). When SNOMED does not offer an official mapping, the team generates a manual cross-link through functionality on the terminology server. We have tested the use of the terminology server for the interactive coding of discharge summaries¹⁹ and have expanded use of the terminology server into other institutions in Argentina, Chile and Uruguay.²⁰ We believe that the use of terminology services can facilitate the display and collection of clinical data by simultaneously linking a user's own free text descriptions to structured data elements in a reference terminology. We agree with the findings of previous studies demonstrating that SNOMED CT has better granularity or is finely detailed for the representation of clinical data.^{21,22}

Comparison with the literature

The prevalence of overweight and obesity is high in the paediatric population analysed in this study. Our data are congruent with a previous estimation of the prevalence of obesity in this population carried out in 2003.²³ The prevalence of overweight and obesity has increased worldwide.²⁴ Positive trends have been

observed in Latin America, and recent data from Argentina have also shown a high prevalence of overweight.⁴

Our results are similar to those of Benson *et al*¹² in that although a clear definition of BMI for the paediatric population exists, a great number of overweight or obese patients remain undiagnosed.

Limitations of the findings

This study has some limitations that need to be highlighted. Even when 5% of the patients were excluded because of extreme values, the percentage is similar to that reported by Benson *et al*,¹² and extreme cut-off points were considered, so this procedure does not represent a potential bias that would affect the results. We did not perform a manual review of a sample of health records to evaluate whether a diagnosis of overweight or obesity had been registered as free text. This may underestimate the prevalence of these conditions based on physician's diagnosis.

The discrepancy between anthropometric data and the record of a clinical diagnosis, referrals and test ordering may be due to different factors. We have recently conducted a qualitative study (unpublished data), from which we were able to identify that physicians at HIBA usually refer patients with a diagnosis of obesity to specialists, but not those that are overweight. Physicians also mentioned that when dealing with overweight and obese patients, unlike other diseases and/or other topics related to preventive practices (e.g. vaccines), they usually feel ineffective and, in this sense, less motivated, which may contribute to insufficient records of the diagnosis in the EHR.

Call for further research

Based on the complexity of obesity, it is necessary to address the problem through multiple approaches and the interventions needed should not only be focused on the population. Interventions in the primary care setting might be an important component of an overall approach to addressing this problem. Strengthening healthcare professionals by the provision of tools that help in early diagnosis. It has been shown that early identification of the risk factors associated with weight gain and being overweight, such as birth weight and early catch-up growth, adiposity rebound and sedentarism, etc., are key points that need to be addressed for its prevention or reduction.²⁵

Previous studies have shown that EHR reminders have the ability to improve physicians' adherence to guidelines and provide preventive services in the outpatient setting,²⁶ but there are few EHRs implemented in primary care practices that include clinical decision

support features or the use of electronic reminders or alerts.²⁷

It has been demonstrated in the adult and paediatric populations that the automatic calculation of BMI can improve the documentation and management of obesity.^{17,28} The implementation of alerts based on BMI values could help to increase the awareness of paediatricians about overweight at early stages so that they can start implementing specific interventions.

Based on our results, it has been decided to start with the development of reminders and alerts in the EHR for primary care physicians, which may help by increasing the awareness and perception on the problem of overweight and obesity in children and adolescents.

At the same time, the analysis of data from an EHR is an excellent way of investigating the quality of health care provided. Completeness and use of information for diagnosis and clinical decision constitute excellent indicators of quality in healthcare settings.

Conclusion

The prevalence of overweight and obesity based on anthropometric data is high in the population studied, even though the estimation based on diagnosis registered by paediatricians is lower. Also, the frequencies of referral to specialists and requests for laboratory tests are low. The EHR provides quick and easy access to anthropometric and clinical data useful in order to evaluate quality of health care, and to facilitate tools to physicians in terms of improving their awareness regarding relevant problems as overweight and obesity.

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CONFLICTS OF INTEREST

None.

ADDRESS FOR CORRESPONDENCE

Paula Otero
Department of Pediatrics
School of Medicine Hospital Italiano de Buenos Aires
Gascon 450
(1181) Ciudad Autonoma de Buenos Aires
Argentina
Tel: +54 11 4959 0200; ext. 8967
Fax: +54 11 4959 0577
Email: paula.otero@hospitalitaliano.org.ar

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